NEWS

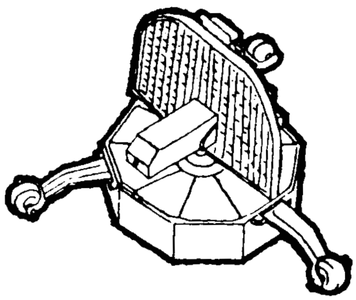
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

TELS. WO 2-4155
WO 3-6925

FOR RELEASE: WEDNESDAY P.M.
October 11, 1967

RELEASE NO: 67-262

PRESS KIT



PROJECT: OSO-D

(To be launched no earlier than Oct. 18)

contents

10/6/67

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FOURTH ORBITING SOLAR OBSERVATORY SCHEDULED

An Orbiting Solar Observatory (OSO-D), designed to study the Sun and its influence in the interplanetary space near the Earth, is scheduled for launching on or after Oct. 18 from Cape Kennedy.

OSO-D, to be called OSO-IV in orbit, will be launched into a 350-mile circular orbit by a three-stage Delta launch vehicle.

Designed to provide observations from space during most of an 11-year solar cycle, the OSO program is one of the National Aeronautics and Space Administration's major efforts in solar physics.

Besides its intrinsic interest, the Sun offers unique opportunities to study the stars and stellar theories, since it is the nearest star to Earth.

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It is the only star close enough for man to observe features such as spots and flares and to permit detailed study of X-rays, gamma rays and radio emissions.

The Sun's cycle of activity declines from a high point during the first seven to nine years, then builds back to a high phase in the remaining years. The present period of maximum change has begun.

The Sun emits energetic particles and electromagnetic radiations of various wave lengths. Part of this solar radiation is absorbed by the Earth's upper atmosphere. The X-ray and ultraviolet radiation produces the region of great electron concentration called the ionosphere. The Earth's atmosphere absorbs most of the ultraviolet and X-rays below 3,000 angstroms (Å) in the electromagnetic spectrum.

The primary objective of OSO-D is to obtain high resolution spectral data (within the 1Å - 1350Å range) from onboard solar experiments pointed toward the Sun. OSO-D is continuing the solar investigations begun by OSOs I, II and III, which were launched in the past three years.

The OSO-D spacecraft weighs 599 pounds. Its nine experiments weigh 235 pounds.

The spacecraft is designed in two sections, an upper sail-like structure which carries the pointing experiments, and a nine-sided base section called the wheel.

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The wheel carries scanning experiments and support equipment such as batteries and telemetry system.

An important feature in OSO-D is its ability to scan across the solar disk, similar to OSO-II. OSO-I and OSO-III could only point directly at the Sun's center. The sail experiment section can operate in both orientation modes, i.e., one with the section kept accurately pointed at the center of illumination of the Sun, the other oriented so that the section can scan the entire solar disk and portions of the corona.

Along with its predecessors, OSO-D has been designed for a lifetime of six months and a pointing accuracy of one minute of arc.

The spacecraft is stabilized in orbit by the rotation of its wheel section. An automatic spin control system keeps it spinning 25 to 40 rpm.

A sail control system keeps this portion of the spacecraft facing the Sun while an automatic pitch control system, using gas jets, maintains the spin axis of the entire spacecraft approximately perpendicular to the direction of the Sun.

OSO-D has a torque coil to augment the automatic pitch control system. The coil, operated on ground command, generates a magnetic field which creates a torque on the spacecraft by reacting with the Earth's magnetic field. This reduces gas consumption and increases life expectancy.

An improved ground control system will permit OSO-D to receive up to 140 commands. OSO-I and II could receive 10 and 70 commands respectively and OSO-III can receive 94 commands.

Experimenters will be aided by a device to determine the roll attitude of the spacecraft by sensing its position in relation to the Earth's magnetic field and Sun direction.

OSO-D will carry a Solar Ultraviolet Scanning Spectrometer in the sail section, capable of transmitting a "picture" (digital numbers) of the Sun.

The "picture" will be recorded in the spacecraft and then transmitted to Earth receiving stations. During approximately five orbits a day, the "picture" will be transmitted from Earth receiving stations at Rosman, N.C., or Fort Myers, Fla., to the Goddard Space Flight Center, Greenbelt, Md. During the other 10 orbits per day, the data will be transmitted from the spacecraft and recorded on tapes at other stations in South America and elsewhere. All tapes will be sent to Goddard for processing.

In addition, virtually instantaneous transmission will permit the experimenter to ask for another picture, possibly in another wavelength, of a rapidly occurring solar event on the satellite's next orbit.

Other OSO-D experiments include two additional pointing experiments, also located in the sail portion, and six placed in five compartments in the wheel.

Sail experiments:

-- Solar X-ray Spectroheliograph

-- Solar X-ray Bragg Crystal Spectrometer

Wheel experiments:

-- Celestial X-ray Telescope

-- Solar X-ray Spectrometer

-- Solar Helium II and Helium I Monochromator

-- Earth Proton-Electron Telescope

-- X-ray Monitor

-- Geocorona/Hydrogen Lyman Alpha Telescope

The first two OSO spacecraft were launched successfully from Cape Kennedy on March 7, 1962 (OSO-I) and Feb. 3, 1965 (OSO-II). The third OSO, launched Aug. 25, 1965, failed to orbit. A fourth OSO (OSO-III) was successfully launched March 8, 1967.

Both OSO-I and II, carrying 13 and eight experiments respectively, surpassed their designed lifetime of six months and together provided about 6,000 hours of scientific information.

OSO-III recently passed its seven-month design lifetime and continues to operate well. The satellite carries nine experiments and has returned more than 4,000 hours of scientific data.

OSO-D experiments have been provided by two U.S. and two British universities, one U.S. government agency and one private company. This is the first OSO to carry foreign experiments. The British experiments were designed and constructed in England and sponsored by the Science Research Council of the United Kingdom.

The OSO program is directed by Physics and Astronomy Programs, Office of Space Science and Applications, NASA Headquarters, Washington, D.C. Project management is under the Goddard Space Flight Center, Greenbelt, Md., which is also responsible for tracking and data acquisition. Launch of the Delta is supervised by Kennedy Space Center's Unmanned Launch Operations (ULO).

The OSO spacecraft are designed and built by Ball Brothers Research Corp., Boulder, Colo., and the Delta by McDonnell-Douglas Corp., Santa Monica, Calif.

TECHNICAL AND BACKGROUND INFORMATION FOLLOWS

OSO ACCOMPLISHMENTS

OSO-I observed more than 140 solar flares and sub-flares. It mapped gamma ray radiation in space, examined energetic particles in the Van Allen radiation belt and studied X-ray and gamma ray radiation from the Sun.

Its findings were especially significant in that they showed the wide discrepancies between solar activity above the Earth's atmosphere compared with observations made on Earth. OSO-I also confirmed the theory that solar plasma or wind emitted from the Sun reaches the Earth's atmosphere.

Scientific findings from OSO-I revealed that changes up to 400 per cent occur in ultraviolet and X-ray emissions from the Sun during periods of increased solar activity. Further insights were gained about the composition and characteristics of the Sun including the presence of ionized helium and iron.

To date, more than 24 scientific papers have been published by the OSO-I experimenters and analysis of information is continuing. On Sept. 7, 1962, OSO-I realized its life expectancy of six months but continued to send useful scientific information for more than one year.

Scientific information returned and analyzed so far by OSO-II shows that:

-- The brightness of the zodiacal light near the ecliptic pole is considerably less than originally thought;

-- There is no appreciable contribution to the zodiacal light from a local cloud of dust (dust particles in the atmosphere over the viewer);

-- There are no rapid changes in the brightness of the sky from above the airglow;

-- The majority of the airglow seen in the visible portion of the spectrum arises in a layer about 56 miles above the Earth;

-- Brightness and color of airglow change with weather conditions and the scale of the airglow is similar to the scale of a large meteorological system;

-- Lightning strikes more over land than water and some geographic regions appear to receive more than others.

OSO-II was placed in a stowed mode on Nov. 6, 1964, because the gas in its automatic pitch control system was almost depleted. At that time, the spacecraft had exceeded its life expectancy of six months by 50 per cent.

Goddard project engineers turned OSO-II back on, perhaps for the last time, on June 1, 1966, and turned it off five days later. The additional engineering data proved especially valuable for determining life expectancy of instruments aboard the spacecraft.

OSO-III, launched Mar. 8, 1967, from Cape Kennedy, Fla., carried nine experiments to continue the pioneering solar physics investigations begun by its two predecessors.

By Mar. 14, all nine experiments carried by the 620-pound observatory were returning data. OSO-III data, still being collected after seven months in orbit, are being analyzed.

Two solar experiments in the pointing section of OSO-III have been operating successfully. A scan of the solar spectrum in the ultraviolet region between 250 angstroms and 1,300 angstroms has allowed scientists to deduce the density of the constituents of the Earth's upper atmosphere with high accuracy and has obtained solar spectra with the best resolution ever achieved, scientists say. Observations of the solar spectrum between 1 angstrom and 400 angstroms have noted changes in the extreme ultraviolet spectrum and correlated these data with solar activity as a function of time.

An experiment which measured the Earth's albedo in the visible spectrum received sufficient data to achieve its scientific goal before it ceased operation.

Measurements of solar X-ray flux between 8 angstroms and 14 angstroms showed large variations in the Sun's X-ray emissions without corresponding visible activity on the disk.

Preliminary results from OSO-III's experiments were announced at the 13th General Assembly of the International Astronomical Union at Prague, Czechoslovakia, in August, 1967.

OSO-C

The OSO-C mission failed. Although the first two stages of the Delta Launch Vehicle performed well, the X-258 solid third stage ignited about 5.5 seconds prematurely.

A study of the failure indicated that the igniter squib in the third stage of the Delta was the most probable cause. Following the ignition signal from the second stage, the squib was programmed to delay the ignition of the third stage for six seconds. This delay did not occur. This was the first failure of its kind in 40 successive Delta launches.

OSO Spacecraft

Sail and Wheel Structure

The sail structure is nearly semicircular with a radius of 22 inches. It is covered with 2,016 solar cells. Behind the solar cell panel are electronic and mechanical components to operate the sail.

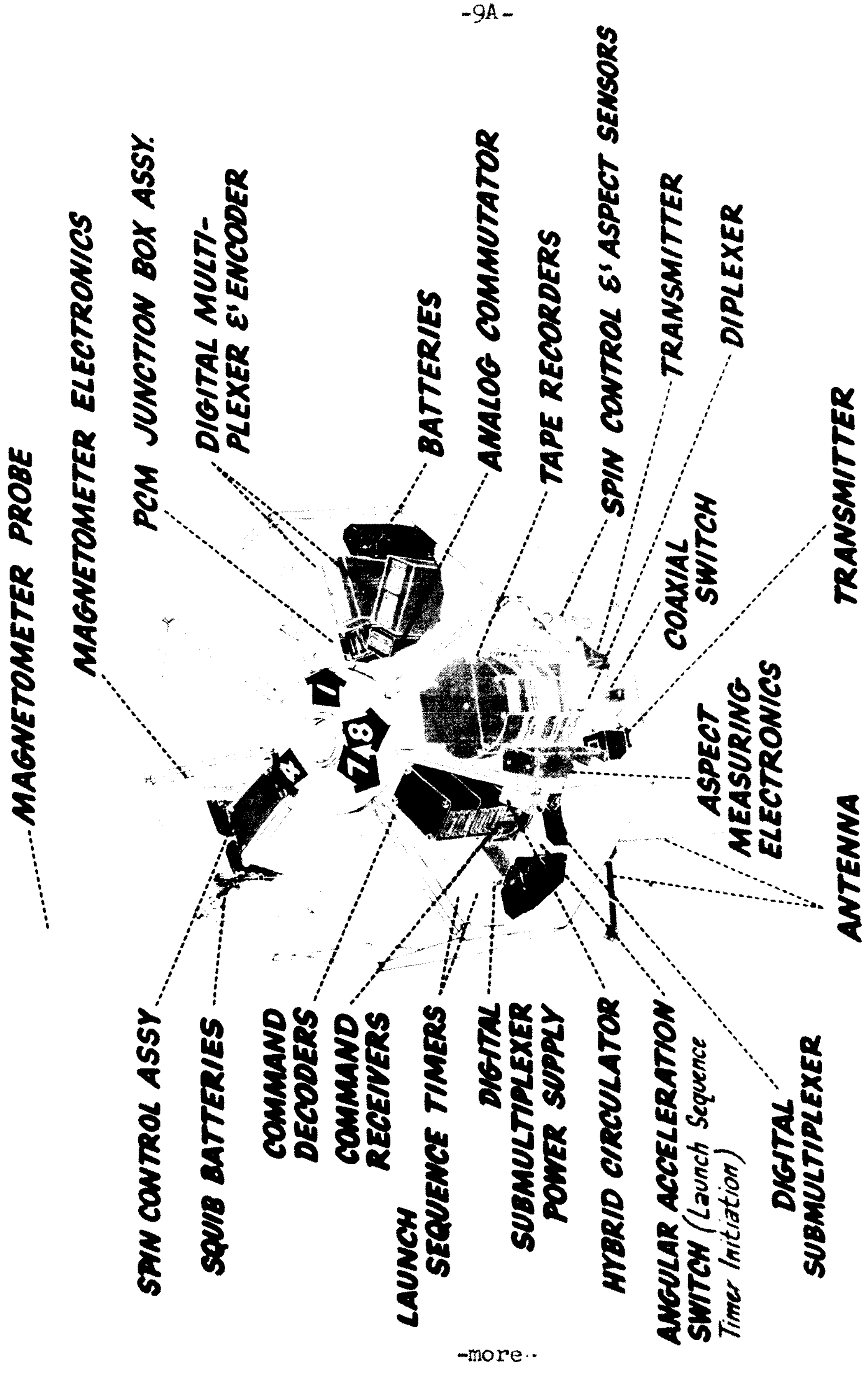
The nine-inch wheel structure is made of aluminum alloy and consists of nine, wedge-shaped compartments each with 1,000 cubic inches of space. Five compartments hold experiments; the remaining four house the electronic controls, batteries, telemetry and radio-command equipment.

In the orbit configuration, three 30-inch arms extend from the wheel section at 120-degree intervals. A six-inch diameter sphere is mounted at the end of each arm, containing nitrogen gas under an initial pressure of 3,000 pounds per square inch.

Automatic Spin Control System

Initial spin-up to 120 rpm is imparted to the spacecraft in the latter stages of powered flight. The spin rate is reduced to about 100 rpm when the spacecraft's three arms are extended, just after third stage burn-out while the OSO is still attached to this stage. A signal from the spacecraft's timer actuates the automatic spin control system on the OSO to de-spin the spacecraft to some 30 rpm and maintain it at this rate.

The automatic de-spin system consists of a set of silicon photoelectric "eyes" on the rim of the wheel section, associated electronics, and three nitrogen gas storage spheres located on the ends of the spacecraft arms. The "eyes" count the frequency at which they "see" the Sun. If the rate exceeds 41 per minute, gas is released through tiny jets in the storage bottles to slow the wheel. If the wheel's spin rate should drop below 26 rpm, jets on the opposite side of the supply bottles are fired to speed up the wheel.



Wheel Electronic Systems

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Sail Control System

While the OSO is in darkness, the sail section rotates with the wheel. Each time the spacecraft moves from behind the Earth into view of the Sun, the sail locks onto the Sun.

Coarse correction of the sail position is provided by two pairs of silicon photo-detector "eyes" which control a servo-motor designed to drive the sail in the opposite direction of the spinning wheel. A pair of the "eyes" is located on each side of the sail section so that all four "eyes" have a 360-degree field of view. Each "eye" is masked so that it has an individual 90-degree field of view. When the pair of "eyes" on the Sun-facing side of the sail sense that they have the full disk of the Sun centered in their "sight", the servo-motor holds the sail facing the Sun within three degrees.

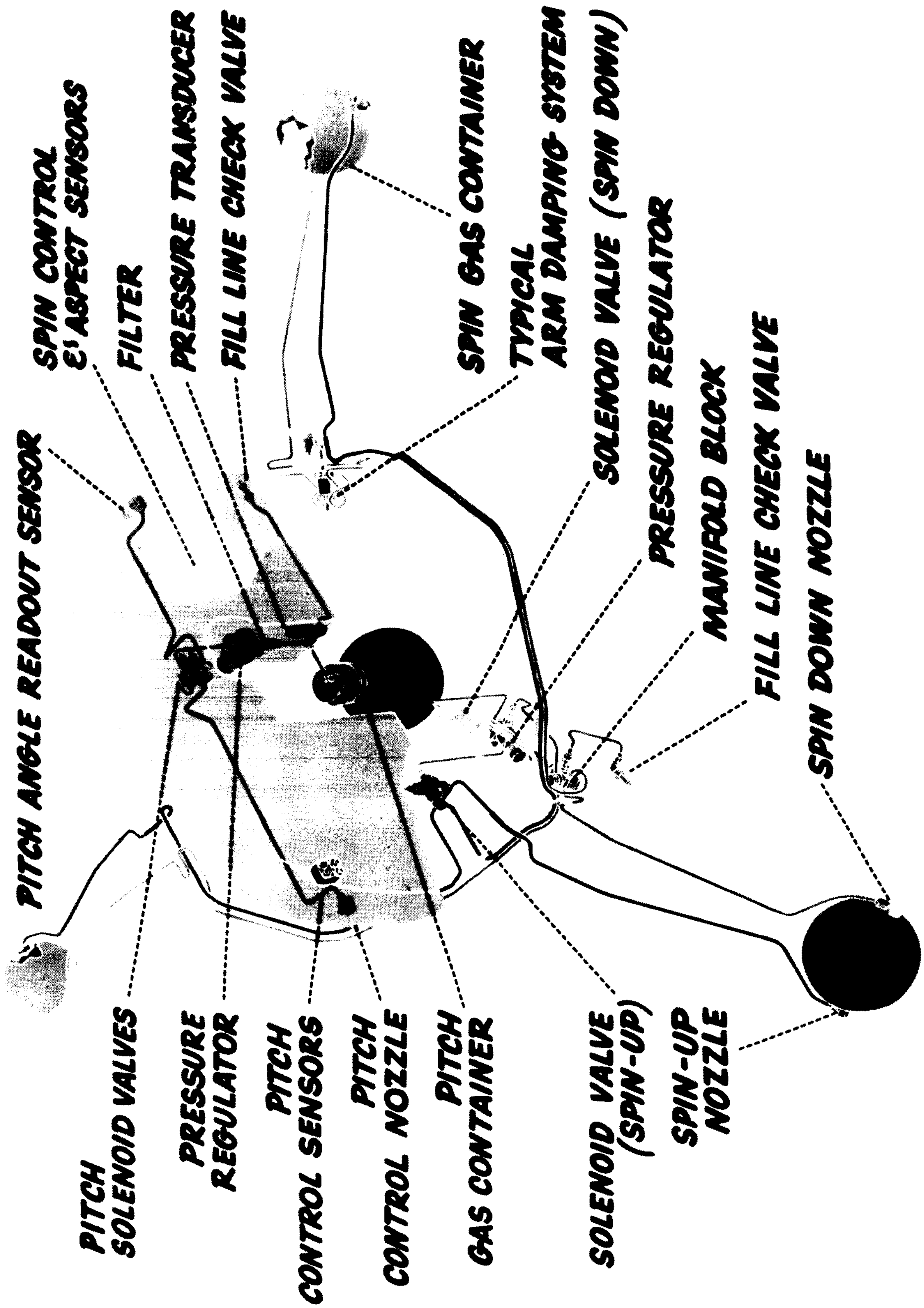
Fine correction of the sail's two pointing experiments within one minute of arc in azimuth and elevation is maintained by two pairs of silicon photo-detector "eyes" located on the viewing end of the experiments. One pair of these "eyes" controls the same servo-motor used for sail de-spin to provide fine azimuth pointing of the experiments. The other pair of "eyes" controls a separate servo-motor for elevation pointing.

Automatic Pitch Control System

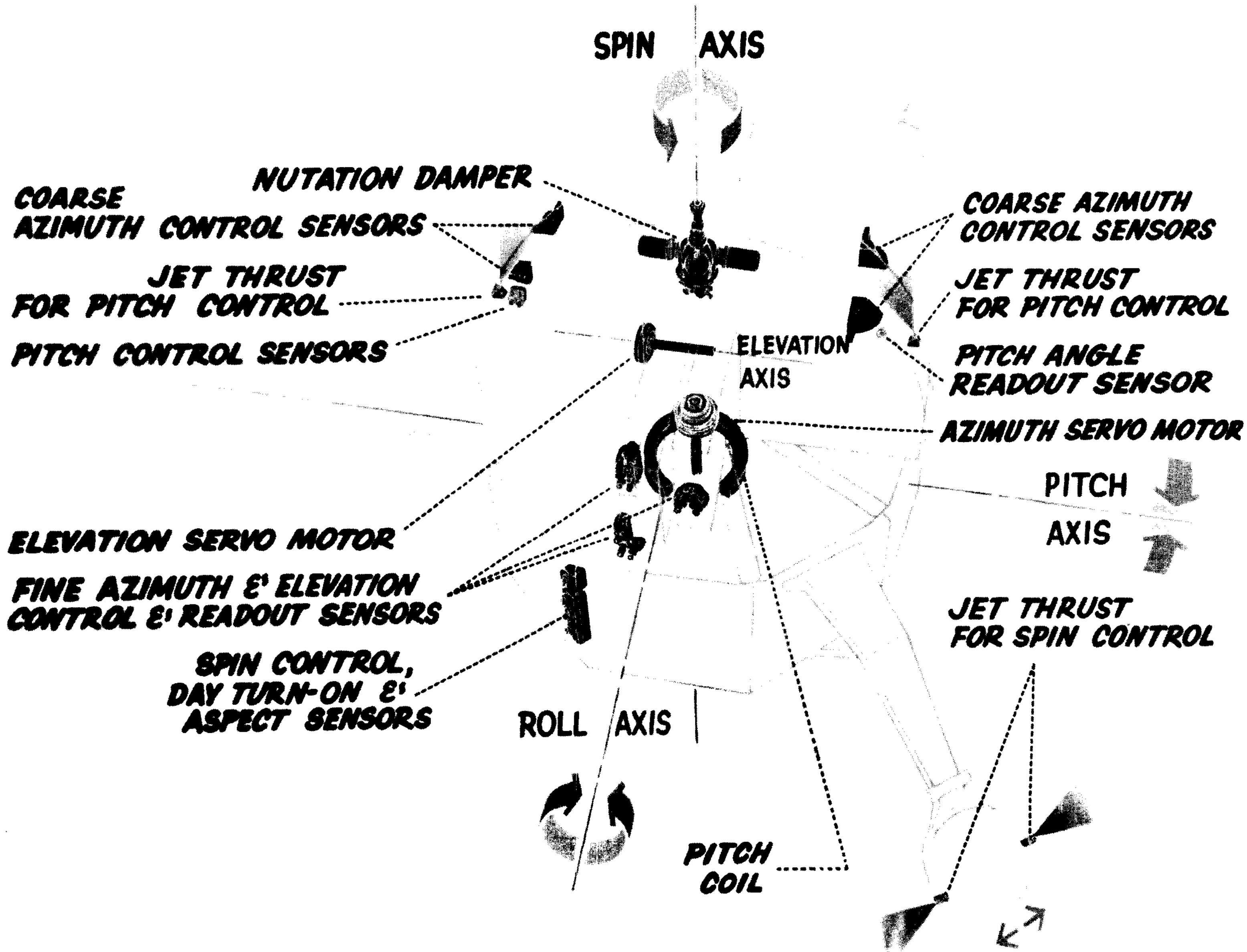
Any pitching motion of the OSO spacecraft, either forward or back, must be corrected if the onboard experiments are to be in a proper position to view the Sun.

Coarse control in pitch is provided by an automatic control system which maintains the spacecraft spin axis perpendicular to the direction of the Sun within three and a half degrees either up or down.

This system essentially consists of a pair of silicon photo-electric "eyes" located on the Sun-side of the sail, the necessary electronics, and a nitrogen gas storage bottle located inside the sail section. Two gas jets are connected to the storage bottle. These are located on top of the sail, one on each side of the spin axis of the spacecraft.



Gas Control Systems



Control Systems

Whenever the "eyes" sense that the spacecraft pitches forward or backward so that the spin axis is less than three degrees from perpendicular to the direction of the Sun, gas is made to flow through one of the jet exhausts. This applies the proper force to correct for the error in pitch.

The automatic pitch control system, which can be worked by command control from the ground, is capable of precessing the entire spacecraft.

Magnetic Torque Coil

A magnetic torque coil is used aboard the OSO to help minimize pitching motions of the spacecraft. Wound around the inside hub of the wheel section, it can be energized in three basic modes by command from the ground. Power to the coil can be turned on or off, it can be changed from full to half-power, and the polarity of the coil can be reversed.

When energized, the coil produces a torquing force which is perpendicular to the coil and which tends to line up perpendicularly with the Earth's magnetic field. Since the force also coincides with the spin axis of the spacecraft, it helps to minimize any pitching motion of the spacecraft.

Aspect Monitoring System

The roll aspect of the OSO attitude must be determined for the benefit of the experimenters, particularly those with experiments on the wheel section. For this purpose, OSO is equipped with an aspect monitoring system which measures the spacecraft's roll position in relation to the direction of the Sun.

This system uses a magnetometer to sense the spacecraft's position relative to a plane in the Earth's magnetic field. Simultaneously, the system produces time pulse which indicate points along the magnetic plane at which the spacecraft sees the Sun.

Information from the aspect monitoring system, along with information on the spacecraft's pitch angle, is compared to known values of the Earth's magnetic field with a ground-based computer to determine the roll angle of the OSO at any given time during its orbit.

Onboard Communications System

The communications system on board OSO-D provides its sole link to the ground once the spacecraft has left the Earth. This system is designed to receive and process command signals, record experiment data, and transmit experiment and spacecraft data to the ground.

A total of 140 different commands can be accepted in digital form by OSO-D. These are received on board the spacecraft by two command receivers which operate on a continuous basis for protection against a single receiver failure. Both receivers are located in the wheel section of the spacecraft.

The output from the command receivers is fed into three decoders for command execution. Capable of decoding a maximum of 70 commands each, the three decoders require individual address commands. Output signals from the decoders actuate latching relays and transistor switches in executing the commands.

Two of the decoders are located in the wheel section to process commands independently for this part of the spacecraft. Commands intended for the sail section are processed by the third decoder located in the sail. Command signals for the sail section are received through the receivers in the wheel section and relayed to the sail section by means of slip rings which are rotating electrical contacts.

As OSO-D orbits the Earth, it will transmit data in real time from its scientific experiments to the ground while simultaneously recording the same data with an on board tape recorder. The recorder operates throughout the spacecraft's orbital period, recording data at the rate of 400 bits of digital information per second.

The spacecraft is commanded, once each orbit, to play back at the high speed rate of 7,200 bits per second. This is 18 times the record speed and requires only about five and one-half minutes.

Upon completion of the playback period, the tape recorder automatically reverts to the record mode and the spacecraft resumes transmitting real-time data.

Spacecraft Power System

During the time OSO-D spends in the sunlight, the spacecraft requires about 26 watts of electric power including 13 watts for spacecraft systems and 13 watts for experiments. (Approximately seven watts are required for nighttime use.)

Electrical energy for OSO is supplied by solar cells. This energy not only powers the spacecraft while it is in the sunlight but simultaneously charges the batteries which provide power for operation at night.

OSO has 2,016 N/P solar cells attached to the Sun-facing side of the spacecraft's sail section. This solar cell array, consisting of 36 parallel strings of 56 cells each, has a total surface area of 4.0 square feet. A maximum of 38 watts of electric power can be provided with this array.

The N/P (N-on-P) solar cell is simply a slice of silicon crystal about 15 thousandths of an inch thick which has phosphor impurities diffused into the top surface and boron impurities diffused into the bottom surface. This design gives the crystal a negative region at the top and a positive region at the bottom. Electrons are made to flow between these two regions when the cell is exposed to sunlight, thereby providing electric power. N/P solar cells are more resistant to space radiation than the P/N solar cells previously used on orbiting spacecraft.

The prime battery pack consists of 42 rechargeable nickel-cadmium type-F cells. Voltage for the battery pack ranges from 16.2 (an undercharge condition) to 22 volts when the pack is fully charged. When the battery voltage drops to 16.2, an under-voltage switch in the spacecraft's power system removes power from most of the spacecraft systems. This safety switch returns power to the affected systems only when the charge is up to 19 volts.

The under-voltage switch does not remove power from the receiver and decoder systems of the spacecraft's wheel section or from the launch sequence timer. Power is supplied continuously to the receivers and decoders so that the spacecraft can be commanded during any under-voltage conditions. The under-voltage switch can be bypassed by a relay upon ground command if so desired.

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The OSO power sub-system also is equipped with a day-night switch which automatically cuts off certain systems to conserve power when the spacecraft is in the dark portion of the orbit. Signals from solar-sensing detectors on the rim of the spacecraft wheel actuate the switch which then turns off the pointed experiments, certain wheel experiments, the pointing-control system and the automatic spin-and-pitch control systems. These systems are turned back on again by the day-night switch when the spacecraft emerges into the sunlight from behind the Earth. Some experiments operate during the entire orbit.

OSO-D EXPERIMENTS

Three of OSO-D's nine experiments are located on the sail portion of the spacecraft and will be pointed at the Sun. The remaining six experiments are located in compartments of the nine-sided rotating wheel section and scan the Sun every two seconds.

Pointed Experiments

Solar X-ray Spectroheliograph

This experiment is provided by American Science and Engineering, Inc., Cambridge, Mass. It will obtain good resolution x-ray Spectroheliograms of the Sun in various wavelengths in periods of both solar quiescence and activity. The wavelengths are 3 to 13 angstroms; 3 to 20 angstroms; 3 to 21 angstroms; and 44 to 70 angstroms.

Analyses of these data will yield information on electron and ion densities in the corona and on the processes involved in solar flares.

This instrument weighs about 25 pounds and operates on 1.5 watts of power.

Solar X-ray Bragg Crystal Spectrometer

Provided by the U.S. Naval Research Laboratory, Washington, D. C., this experiment is designed to determine spectrally the difference in the make-up of the Sun in flare and non-flare periods in the region of one to eight angstroms. Further, it will be used to distinguish between thermal and non-thermal mechanisms in the x-ray emission process for this region. This instrument is designed to continue the investigation first started with a similar instrument on OSO II.

This instrument weighs about 25 pounds and operates on 1.25 watts of power.

Solar Ultraviolet Scanning Spectrometer

This experiment was developed by the Harvard College Observatory, Cambridge, Mass., and is similar to a Harvard experiment on OSO II. It is designed to scan a wavelength region of the solar ultraviolet spectrum between 300 and 1,300 angstroms.

Upon command, the instrument will set at any wavelength within its range and use the observatory's capability for scanning in a back-and-forth motion to construct an image of the Sun at the desired wavelength. Due to the detail-scan coverage time of the Sun (4.25 minutes), these images will have a moderately good time resolution for rapidly occurring solar events.

This spectrometer weighs about 40 pounds and uses about two watts of power.

Due to the versatility of this experiment, a special data line has been established to link Harvard with the Goddard Space Flight Center in Greenbelt, Md., for "real time" acquisition of the instrument's data. Information from OSO-D experiments will be sent Goddard by landline from the STADAN facility at Ft. Myers, Fla., where it will be read out of the spacecraft after each orbit. Data from the Harvard experiment will be recovered and computer processed at Goddard.

By this means, the Harvard experimenters can analyze their data and elect to have their experiment command to change its mode of operation during each orbit to observe a particular solar occurrence.

Wheel Experiments

Celestial X-ray Telescope

This experiment is provided by American Science and Engineering, Inc., Cambridge, Mass. It is designed to survey the night sky for cosmic sources of x-radiation with energies from one-half to 30 kev. Both point sources of radiation as well as a general background of x-rays originating in the celestial sphere are expected to be revealed by the surveys with this instrument.

Information from such a survey will prove useful for determining extra-solar sources of x-radiation and secondly their effects upon future manned space travel.

Weighing about 25 pounds, this instrument requires almost one watt of power for its operation.

Solar X-ray Spectrometer

Provided by the University College, London, England, and the University of Leicester, England, this experiment is designed to detect solar x-rays in the wavelength ranges of 1-20 angstroms and 44-75 angstroms.

Study of the radiation in this region of the spectrum under both quiet and active solar conditions can lead to a better understanding of the state of the solar corona.

This instrument weighs about 29 pounds and uses a little less than one watt of power for operation.

Solar Helium II and Helium I Monochromator

This experiment is provided by the University College, London, England. It is designed to monitor the total flux of helium II radiation at the 304 angstrom energy level with a time resolution of about two seconds. In addition, this instrument can be commanded to sample hydrogen radiation at the 1,216 angstrom level.

Such information will be useful in helping to determine how changes in the helium radiation from the Sun affect the Earth's ionosphere.

Weighing 26 pounds, this instrument requires 0.5 watts of power for operation.

Earth Proton-Electron Telescope

Provided by the University of California, Lawrence Radiation Laboratory, Livermore, Calif., this experiment will detect the protons and electrons encountered by the observatory. It will measure the energy dependence and the angular distribution of these particles relative to the local magnetic field.

Information collected with this instrument will be used to study the buildup and loss mechanisms of the radiation trapped in the local magnetic field. Of particular interest is the effect of longitudinal variations in the Earth's magnetic field as well as the effect of solar cycle variations on the proton population.

This experiment weighs 33 pounds and requires one watt of power for operation.

X-ray Monitor

This experiment is provided by the U.S. Naval Research Laboratory, Washington, D. C. It will measure the energy input to the Earth's atmosphere in the spectral bands of 0.5 to 3.0 angstroms; 2 to 8 angstroms; 8 to 16 angstroms; and 44 to 60 angstroms.

These measurements will provide a good characterization of solar emission. They will provide a set of x-ray indexes against which other geophysical parameters can be correlated. Such indexes will indicate time variations in solar events and will provide a method of classifying solar events more quantitatively than the present type of solar activity classifications.

This experiment weighs about eight pounds and uses two watts of power for its operation.

Geocorona/Hydrogen Lyman-Alpha Telescope

The U.S. Naval Research Laboratory provided this experiment to scan and record Lyman-alpha night skyglow which results from scattering by the solar hydrogen in the Earth's corona. The energy range of this instrument extends from 1,050 to 1,350 angstroms.

Information collected with this instrument will help provide a better understanding of how hydrogen emissions from the Sun are absorbed in the Earth's upper atmosphere.

This instrument weighs 24 pounds and uses one watt of power.

OSO-D FACT SHEET

Spacecraft

Weight:	About 599 pounds (235 pounds of scientific instruments and associated equipment)
Shape:	Base section: nine-sided wheel with three arms carrying spin control gas supply; top section: fan-shaped with pointing instrumentation.
Size:	Wheel diameter: 44 inches, increased to 92 inches with three arms extended. Overall height: 38 inches.
Lifetime:	Designed for six months useful lifetime.

Launch Phase

Site:	Complex 17, Cape Kennedy, Eastern Test Range.
Date:	No earlier than Oct. 18.
Vehicle:	Three-stage Delta Launch Vehicle.
Azimuth:	108 degrees.
Launch Window:	11:56 a.m. to 12:19 EDT
Orbital plan:	Circular orbit about 350 miles altitude. Period: About 95 minutes. Inclination: 33 degrees to the Equator.

Power Subsystem

Solar power supply:	Maximum 38 watts provided by 4.0 square feet of N/P solar cells arranged in 36 parallel strings of 56 cells each on Sun-facing side of sail section.
Typical maximum load:	About 26 watts including 13 watts for experiments. About 7 watts required at night.

DELTA LAUNCH VEHICLE

Delta is a launch vehicle program of NASA's Office of Space Science and Applications. Project management is the responsibility of the Goddard Space Flight Center. The Kennedy Space Center's Unmanned Launch Operations Directorate provides launch operations support. Delta prime contractor is the McDonnell-Douglas Corp.

OSO-D will be the 53rd satellite to be launched by Delta. If the launch sequence is successful, OSO-D will be the 50th satellite orbited by Delta.

Delta Statistics

The three-stage Delta for the OSO-D mission is the DSV-3C/FW-4 configuration. It has the following characteristics:

Height: 92 feet (including shroud)

Maximum Diameter: 8 feet

Lift-off Weight: about 75 tons

Lift-off Thrust: 172,000 pounds

First Stage: Modified Air Force Thor, produced by McDonnell-Douglas Corp., engines produced by Rocketdyne Division of North American Aviation.

Diameter: 8 feet

Height: 51 feet

Propellants: RP-1 kerosene is used as the fuel and liquid oxygen (LOX) is utilized as the oxidizer.

Thrust: 172,000 pounds

Burning time: 2 min. 29 sec.

Weight: more than 50 tons.

Second Stage: Produced by the McDonnell-Douglas Corp.; utilizing the Aerojet-General Corp. propulsion system; major contractors for the autopilot are Honeywell, Inc., Texas Instrument, Inc., and Electrosolids Corp.

Diameter: 2.7 feet

Height: 20.6 feet

Propellants: Liquid Unsymmetrical Dimethyl Hydrazine (UDMH) for the fuel and Inhibited Red Fuming Nitric Acid (IRFNA) for the oxidizer.

Thrust: about 7,500 pounds

Burning Time: 2 min. 31 sec.

Weight: $2\frac{1}{2}$ tons

Guidance: Western Electric Co.

Third Stage: United Technology Center FW4 motor

Diameter: $1\frac{1}{2}$ feet

Height: $5\frac{1}{2}$ feet

Propellants: solid

Thrust: 5,600 pounds

Burning Time: 23 sec.

Weight: 660 pounds

Spacecraft Separation

Upon completion of third stage burnout, but before spacecraft separation, three arms on the OSO-D spacecraft extend. This slows the spin rate to about 100 rpm.

After spacecraft separation, the de-spin system is actuated by a signal from the spacecraft timer and the spacecraft spin rate is slowed to the desired 30-40 rpm.

About 20 minutes after lift-off, OSO acquires the Sun.

NOMINAL OSO-D FLIGHT EVENTS

EVENT	TIME	ALTITUDE STATUTE MILES	SURFACE RANGE STATUTE MILES	VELOCITY MILES PER HOUR
Main Engine Cutoff	2 min. 29 sec.	56	92	9,705
Second Engine Cutoff	5 min.	199	522	13,391
Third Stage Ignition	11 min. 22 sec.	345	1,784	12,622
Third Stage Burnout	11 min. 45 sec.	345	1,867	16,022
Spacecraft Separation	18 min. 36 sec.	345	3,709	16,022

TRACKING, DATA ACQUISITION AND COMMAND STATIONS

The ground stations with prime responsibility to track, acquire data or command the OSO spacecraft are part of the NASA's Space Tracking and Data Acquisition Network (STADAN), operated by the Goddard Space Flight Center. In addition, selected stations of the Manned Space Flight Network will be used during launch period.

Tracking

The following STADAN stations will track the spacecraft: Orroral, Australia; Fort Myers, Fla.; Quito, Ecuador; Lima, Peru; Santiago, Chile; Johannesburg, South Africa, and Tananarive, Malagasy Republic.

Data Acquisition

The following STADAN stations will acquire data from the OSO: Orroral, Australia; Fort Myers, Fla.; Rosman, N.C.; Quito, Ecuador; Lima, Peru, and Santiago, Chile. During the launch and early orbit phase the following stations will also acquire data: Antigua, Ascension, Hawaii,and Mojave, Calif.

Upon command, the spacecraft tape recorder will be read out at least once per orbit. The recorder has a 100-minute data storage capability but is played back in about 5.5 minutes at 18 times the recorded rate. Both the tape recorder playback data and real-time data from the spacecraft will be recorded by the ground stations.

Normal readout of the recorder will occur once in each orbit by one of the stations in North Carolina, Florida or South America. If necessary, several of these stations will be able to record the data simultaneously. The three remaining stations in Africa, Australia and California will command data from the spacecraft twice a week to maintain an operational capability with the spacecraft.

Command

All commands for the OSO are initiated in the OSO Control Center at Goddard but are actually generated at one of the field stations. The more complex commands are generated at the Fort Myers, or the Rosman station, which is used as a back-up. Tape recorder commands are also generated at one of the remaining stations. This arrangement provides for flexible control of the spacecraft and its experiment operating modes.

OSO TEAM

NASA HEADQUARTERS

Jesse L. Mitchell	Director, Physics and Astronomy Programs, OSSA
C. D. Ashworth	Program Manager for Solar Observatories
E. B. Stubbs	OSO Program Engineer
Dr. H. Glaser	OSO Program Scientist
Vincent L. Johnson	Director, Launch Vehicle and Propulsion Programs
Robert Manville	Delta Program Manager

GODDARD SPACE FLIGHT CENTER

Dr. John F. Clark	Director
Laurence T. Hogarth	OSO Project Manager
William R. Schnidler	Delta Project Manager

BALL BROTHERS RESEARCH CORP.

Dr. R. C. Mercure	Director
R. Marsh	OSO Project Manager

McDONNELL-DOUGLAS CORP.

Marcus F. Cooper	Director, Florida Test Center, Cape Kennedy
J. Kline	Delta Systems Engineer

EXPERIMENTERS FOR OSO-D

Pointed:

American Science and Engineering, Inc. Cambridge, Mass.	Solar X-ray Spectroheliograph, R. Giacconi
U. S. Naval Research Laboratory, Washington, D.C.	Solar X-ray Bragg Crystal Spectrometer, H. A. Friedman
Harvard University, Cambridge, Mass.	Solar Ultraviolet Scanning L. Goldberg

Wheel:

American Science and Engineering, Inc., Cambridge, Mass.	Celestial X-ray Telescope R. Giacconi
University College, London, and University of Leicester, England	Solar X-ray Spectrometer R. L. F. Boyd
University College, London, England	Solar Helium II and Helium I R. L. F. Boyd
Lawrence Radiation Lab. U. of Calif., Livermore, Calif.	Earth Proton-Electron Telescope, J. Waggoner
U. S. Naval Research Laboratory, Washington, D.C.	X-ray Monitor T. A. Chubb
U.S. Naval Research Laboratory	Geocornal Hydrogen Cyman Alpha Telescope P. W. Mange

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